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Short communication: Eating and rumination activity in 10 cows over 10 days

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ABSTRACT

Eating and rumination activities were evaluated in 10 Brown Swiss cows over 10 days, and the coefficients of variation (CV) were calculated for the investigated variables. A pressure sensor integrated into the noseband of a halter recorded jaw movements during chewing, which allowed the recording of eating and rumination times and the number of regurgitated boluses. The mean CVs ranged from 5.9 to 12.7 % and were smaller for rumination (chewing cycles per bolus, 5.9 %; daily number of cuds, 8.4 %; rumination time, 9.1 %) than for eating (eating time, 12.0 %; chewing cycles related to eating, 12.7 %). We concluded that of eating and rumination variables examined, the number of chewing cycles per regurgitated bolus is the most robust with little variation in individual cows.

Keywords: Cattle; Eating; Rumination; Variation; Coefficient of variation

Several methods have been developed for automated recording of eating and (or) rumination variables in cattle (Luginbuhl et al., 1987; Matsui and Okubo, 1991; Lindgren, 2009; Schirmann et al., 2009). The technique used in our clinic is based on a pressure sensor integrated into the noseband of a halter that records pressure changes caused by jaw movements. In a first study, ten cows were fitted with a recording halter for 24 hours, and the recordings were compared with those obtained by direct visual observation (Braun et al., 2013). There was complete or almost complete agreement between data obtained via direct observation and pressure sensor technique, and phases of eating and rumination were easily distinguished in the automated recordings. In further studies, we generated reference ranges for eating and rumination in 300 cows (Zürcher, 2014) and investigated these same variables in cows in the peripartum period (Braun et al., 2014). For experimental purposes, it is convenient to record various activities during a 24-hour period, but we have not critically evaluated whether the pattern established during one day accurately reflects the eating behaviour of a cow. The goal of this study was therefore to record eating and rumination in ten cows continuously for ten days and analyse the variation coefficients of the various variables.

Ten healthy Brown Swiss cows were used. They were 4.4 ± 1. 5 years of age, 12.5 ± 5.0 weeks postpartum and had a daily milk yield of 28.4 ± 2.9 kg. They were kept in tie stalls and fed hay ad libitum during the day. Corn silage was fed several times a day and concentrate twice a day according to the level of production.

Eating and rumination activities were recorded in each cow for ten days using a pressure sensor integrated into the nose band of a halter (Fig. 1, 2) (Braun et al., 2013; Zürcher, 2014). The coefficient of variation (CV), defined as the ratio of the standard deviation to the mean and expressed as a percentage, was calculated for all variables.

The mean daily eating time of all cows was 316 ± 48 minutes (Table 1) and the mean CV was 12.0 % (4.4 to 18.0 %, Table 2). The mean daily number of chewing cycles (defined as a complete course of movement of the mandible during a single masticatory stroke) during eating was 19,951 ± 2,968 (13,881 to 24,465) and the mean CV was 12.7 % (4.4 to 16.8 %). The daily eating times and the daily number of chewing cycles during eating did not differ within cows ($P > 0.05$).

The mean daily rumination time of all cows was 368 ± 54 minutes (Table 1) and the mean CV was 9.1 % (3.2 to 16.4 %, Table 2). The mean daily number of regurgitated boluses was 502 ± 43 and the mean CV was 8.4 % (5.2 to 13.2 %). The mean daily number of chewing cycles per bolus was 49 (38 to 60) and the mean CV was 5.9 % (1.5 to 12.9 %).

The mean overall CVs for the five eating and rumination variables calculated from the ten daily recordings ranged from 4.7 to 13.9 % (Table 2) and were $\leq$ 10.0 % in seven cows.

Notably, the rumination variables had smaller CVs than the eating variables. Although the external conditions did not change noticeably during the ten-day study period; the eating variables were more strongly affected by external factors than rumination variables. Several health disorders can affect feed intake in cattle but none occurred in this study. Social interactions that could interfere with feeding are minimal in cows kept in tie stalls. Individual animal factors and ration effects must therefore be considered as causes for the variations. One individual was responsible for feeding the cows and endeavoured to keep the rations consistent; however, the feed was not weighed and small variations from one feeding to another cannot be ruled out. Only three cows (nos. 3, 4, 10) had feeding-related CVs of < 10 %, and these cows also had rumination-related CVs of < 10 %. In the remaining seven cows, these CVs ranged from 12.3 to 18.0 % and 11.5 to 16.8 %, respectively.

Rumination is affected by various factors (DeBoever et al., 1990), most notably by the structure of the forage. Some studies reported shorter rumination times for forage with shorter particle size (Yansari et al., 2004; Yang und Beauchemin, 2006; Adin et al., 2009) but this was not confirmed by another study (Suarez-Mena et al., 2012). Forage with larger particle size may lead to increased eating and rumination times, increasing chewing rate, or both (Yang und Beauchemin, 2006). The cows of this study were fed the same ration throughout the study period, and therefore the effect of particle size on rumination variables variables was neglected. Likewise, the effect of hypocalcaemia and acute mastitis, which have a proven negative impact on rumination (Hansen et al., 2004, Fogsgaard et al., 2013), were also neglected because these diseases did not occur in the present study. Stress and anxiety reduce rumination activity (Herskin, 2004; Bristow und Holmes, 2007), but could also be ruled out. The CVs for rumination variables were much smaller than CVs for the feeding variables in the present study, and a CV of > 10 % occurred for the number of cuds in only five cows (nos. 1, 2, 5, 7, 8), for rumination time in three cows (nos. 2, 5, 7) and for the number of chewing cycles per cud in one cow (2). Of all investigated variables, the latter appears the most robust with little variation in individual cows. The number of chewing cycles per bolus is an excellent criterion to differentiate healthy and diseased cows. Cows with left displacement of the abomasum had significantly fewer chewing cycles per bolus compared with healthy controls (Braun et al., 2015), and within five days of corrective right-flank omentopexy, the number of chewing cycles increased significantly accompanied by improvement in the overall condition of the cows. Cows with right displacement of the abomasum, caecal dilation and hardware disease also had considerably fewer chewing cycles per bolus than healthy cows (Tschoner, 2013).

Interestingly, three cows with relatively constant eating variables (nos. 3, 4, 10) also had relatively constant rumination variables, and three cows with less constant eating variables (nos. 2, 5, 7) also had less constant rumination variables.

From this study it was concluded that of all eating and rumination variables examined, the number of chewing cycles per regurgitated bolus is the most robust with little variation in individual cows.

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Legend to Figures

Fig. 1. Brown Swiss cow with a recording halter for the investigation of eating and rumination behaviour. The blue noseband contains the pressure sensor and the brown leather pouch the UBS logger.

Fig. 2. The pressure sensor (in an oil-filled tube, to the right) is attached to the USB logger (in transparent plastic casing, to the left).

Table 1

Coefficients of variation of eating and rumination variables of 10 Brown Swiss cows recorded over 10 days.

Variable	Mean ± sd (range)	Variation coefficient (range)
Eating time (min)	316 ± 48 (219 – 382)	12.0 (4.8 – 18.0)
Chewing cycles during eating	19,951 ± 2,968 (13'881 – 24,465)	12.7 (4.4 – 16.8)
Rumination time (min)	368 ± 54 (262 – 467)	9.1 (3.2 – 16.3)
Number of bolus	502 ± 43 (436 – 559)	8.4 (5.2 – 13.2)
Chewing cycles per bolus	49 ± 7 (38 – 60)	5.9 (1.5 – 12.8)

Table 2

Coefficients of variation (expressed as percentage) for eating and rumination variables in 10 Brown Swiss cows calculated from 10 daily recordings.

Variable	Cow									
	1	2	3	4	5	6	7	8	9	10
Eating time	14.4	15.3	7.3	4.8	18.0	12.3	14.5	12.6	12.5	8.6
Chewing cycles related to eating	14.3	15.1	8.6	4.4	16.2	11.5	16.5	14.1	16.8	9.2
Rumination time	9.5	15.3	7.5	6.0	15.7	7.1	16.4	5.1	5.4	3.2
Number of boluses	10.4	10.3	6.3	5.7	13.2	6.5	10.9	10.0	5.2	6.1
Chewing										

cycles per bolus	1.5	12.9	5.0	2.4	6.4	7.8	7.5	2.8	5.4	7.1
Mean CV (total)	10.0	13.8	6.9	4.7	13.9	9.0	13.2	8.9	9.1	6.8